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(54) Vacuum response type carburetor.

(57) A vacuum response type carburetor (1) is provided with a diaphragm device (3) including a diaphragm chamber separated into two chambers (A,B) by means of a diaphragm (12) and provided with a carburetor body including a venturi passage (5) which is communicated with the diaphragm chamber and in which a throttle valve (7) is disposed. A pressure change within the venturi passage (5) caused by opening and closing the throttle valve (7) is transmitted to the diaphragm chamber and the diaphragm (12) is thereby moved up and down thereby opening and closing a piston valve (6) interlocked with the diaphragm (12) and a fuel (21) is then sucked from a float chamber (4). The diaphragm (12) is formed of hydrogen impregnated nitrile butadiene rubber (NBR). Seal members such as gasket (30) and O-rings (31,32,33 etc) disposed in the carburetor (1) to portions requiring liquid-proof property are also formed of the hydrogen impregnated NBR.

EP 0 655 552 A1

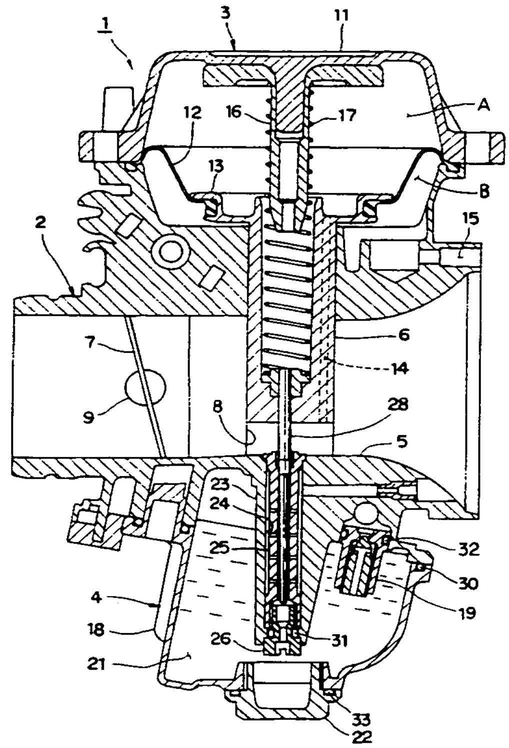
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FIG. 1

BACKGROUND OF THE INVENTION

The present invention relates to a vacuum response type carburetor provided with an improved diaphragm device.

A vacuum response type carburetor which is mainly used for a motorcycle has a structure in which a pressure change, within a venturi passage in the carburetor, caused by opening and closing of a throttle valve is transmitted to a diaphragm disposed in a diaphragm chamber device to thereby open or close a piston valve interlocked with the diaphragm.

That is, when a throttle grip of the motorcycle is operated, a butterfly-type throttle valve provided within the venturi passage opens or closes, and then, the pressure within the venturi passage is raised or lowered thereby. This pressure change is transmitted to the diaphragm device, and the diaphragm disposed in the diaphragm chamber and made of a rubber thin film is moved, so that the piston valve which is interlocked with the diaphragm is also moved to thereby adjust the passage area of the venturi passage and the amount of fuel to be delivered. Consequently, an air-fuel mixture of an optimal air-fuel ratio according to the degree of opening of the throttle valve is always provided to the engine side, thus maintaining engine properties and fuel consumption to a desired condition.

Since the diaphragm of the carburetor is perpetually exposed to a mist of gasoline which is the fuel for the engine, the diaphragm is formed, in the prior art, of a rubber material having chemical-resistant property, such as hydrine rubber or NBR (nitrile butadiene rubber).

However, qualities of gasolines are different in various countries, in some case, the quality is lesser than that in Japan, and accordingly, there is a possibility of adhering a gasoline of poor quality to the diaphragm and hence advances the deterioration of the diaphragm.

For example, since the hydrine rubber is apt to swell in use of the gasoline of poor quality, a diaphragm formed of the hydrine rubber may become soft and deteriorate, leading to early rupturing. On the other hand, a diaphragm formed of the NBR may become hard and deteriorate, thereby obstructing smooth sliding of a piston valve assembled in a carburetor.

A high-octane gasoline and an alcohol fuel have a tendency to cause the diaphragm to deteriorate as compared to a regular gasoline.

In the above regard, in the prior art, the diaphragm is formed thicker in order to slow the deterioration from the gasoline of poor quality, the high-octane gasoline and the alcohol fuel to prevent early rupturing and obstruction of smooth sliding of the piston valve. However, when the thickness of the diaphragm is increased, the rigidity of the diaphragm increases and the flexibility thereof decreases, so that the sliding friction of the piston valve increases. As a result, the piston valve cannot slide quickly, and consequently, the throttle response is made worse.

SUMMARY OF THE INVENTION

An object of the present invention is to substantially eliminate defects or drawbacks encountered in the prior art and to provide a vacuum response type carburetor capable of preventing deterioration of a diaphragm caused by a gasoline of poor quality, high-octane gasoline and alcohol fuel, etc. to maintain an improved throttle response.

Another object of the present invention is to provide a vacuum response type carburetor capable of protecting seal members such as gaskets, O-rings, etc. from deterioration caused by gasoline of poor quality, high-octane gasoline and alcohol fuel, etc.

These and other objects can be achieved according to the present invention by providing a vacuum response type carburetor which is provided with a diaphragm device including a diaphragm chamber separated into two chambers by means of a diaphragm and provided with a carburetor body including a venturi passage which is communicated with the diaphragm chamber and in which a throttle valve is disposed, wherein a pressure change within the venturi passage caused by opening and closing the throttle valve is transmitted to the diaphragm device and the diaphragm is moved up and down thereby opening and closing a piston valve interlocked with the diaphragm, characterized in that the diaphragm is formed of hydrogen impregnated nitrile butadiene rubber (NBR).

Furthermore, seal members such as gasket and O-rings disposed in the carburetor to portions requiring liquid-proof property are formed of the hydrogen impregnated NBR.

A fluoro rubber may be substituted for the hydrogen impregnated NBR.

According to the present invention of the characters described above, the hydrogen impregnated NBR has higher chemical-resistant properties than conventionally used hydrine rubber or NBR, so that the usage of the NBR materials results in prevention of deterioration of the diaphragm caused by gasoline of poor

quality, high-octane gasoline and alcohol fuel, etc., and effectively avoids early rupturing, hardening, etc. of the diaphragm.

Furthermore, since the tensile strength of the diaphragm greatly improves over that of the conventional one, the thickness of the diaphragm can be made thinner, thus improving the throttle response greatly.

The formation of the seal members of the hydrogen impregnated NBR can prevent the deterioration of these seal members, thereby effectively preventing fuel leakage and improper settings of elements.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a vertical sectional view of a vacuum response type carburetor according to one embodiment of the present invention;

Fig. 2 is also a vertical sectional view of the vacuum response type carburetor of Fig. 1 with a piston valve ascended; and

Fig. 3 is a graph showing a relationship of an ascending acceleration of the piston valve after the throttle valve has been opened with respect to the time elapsed.

DESCRIPTION OF THE PREFERRED EMBODIMENT

One preferred embodiment of the present invention will be described hereunder with reference to the accompanying drawings, in which Fig. 1 is a vertical sectional view of a vacuum response type carburetor 1 according to the present invention used for a motorcycle, for example, in which the right as viewed is the air cleaner side and the left is the engine side.

The vacuum response type carburetor 1 is mainly comprises a carburetor main unit 2, which is provided with a diaphragm device 3 to the upper side thereof and with a float chamber 4 to the lower side thereof. This carburetor main unit 2 is formed with a venturi passage 5 passing through the entirety thereof in a horizontal direction. A piston valve 6 and a butterfly type throttle valve 7 are disposed within the venturi passage 5. The piston valve 6 freely moves vertically along a guide passage 8 which intersects with the venturi passage 5. On the other hand, the throttle valve 7 freely rotates around a supporting shaft 9.

The diaphragm device 3 is covered by a diaphragm cover 11 in a liquid-proof manner on the upper portion of the carburetor main unit 2, and the inner space defined thereby is separated by a diaphragm 12 into an upper chamber A and lower chamber B, and the diaphragm 12 is formed of a rubber material such as hydrogen impregnated NBR or fluoro rubber.

The diaphragm 12 is formed so as to provide, for example, a doughnut-shape with the outer periphery thereof being nipped between the diaphragm cover 11 and the carburetor main unit 2 and with the inner periphery thereof being fitted into a flange 13 formed on the head portion of the piston valve 6.

The upper chamber A of the diaphragm device 3 is connected to the venturi passage 5 by means of a connecting passage 14 formed in the piston valve 6, and on the other hand, the lower chamber B is opened to the air cleaner side (atmosphere side) by means of a connecting passage 15 formed in the carburetor main unit 2.

A guide rod 16 is secured to the diaphragm cover 11, and a spring 17 which is pressed between the guide rod 16 and the piston valve 6 forces the piston valve 6 downwards. Consequently, the central potion of the diaphragm 12 is also forced downward. The inner volume of the upper chamber A is made greater than that of the lower chamber B.

The float chamber 4 is covered by a chamber casing 18 in a liquid-proof manner on the lower portion of the carburetor main unit 2, and a fuel 21 is provided from a nozzle 19 having a front end disposed in the float chamber 4. The fuel surface is maintained constant by means of a float device, not shown, and a drain bolt 22 is applied to the float chamber 4.

A boss 23 is formed integrally on the lower side of the carburetor main unit 2 so as to extend into the float chamber 4, and a suction passage 24 which communicates with the venturi passage 5 is formed within the boss 23. A needle jet 25 is inserted into the suction passage 23 from the upper side, as viewed, thereof and a main jet 26 is engaged with the lower end of the boss 23 so as to be screwed with the needle jet 25 from the lower side thereof. The needle jet 25 is formed with a central passage 27, as shown in Fig. 2, through which the fuel is sucked upward, and the lower portion of the central passage 27 is narrowed by the main jet 26 to thereby adjust the quantity of the fuel flow.

A needle valve 28 is fixedly mounted to the lower portion of the piston valve 6, and the needle valve 28 has a tapered outer periphery so that the needle valve 28 axially moves with a circumferential space though the central passage 27 of the needle jet 25 in accordance with the moving of the piston valve 6.

Seal members, such as a gasket 30 which seals the joint between the carburetor main unit 2 and the float chamber casing 18, an O-ring 31 provided between the needle jet 25 and the main jet 26 and O-rings 32 and 33 provided on the nozzle 19 within the float chamber 4 and on the drain bolt 22, are or may be also formed of the hydrogen impregnated NBR or fluoro rubber.

The throttle valve 7 is opened in accordance with the rotated degree of a throttle grip provided on the handlebar of a motorcycle, and the piston valve 6 opens according to the change in pressure within the venturi passage 5. That is, as shown in Fig. 1, in the case where the throttle valve 7 is in the opened state, the suction vacuum is not exerted upon the inside of the venturi passage 5, so that the piston valve 6 does not ascend and the passage area of the venturi passage 5 is minimal. At this time, the fuel 21 within the float chamber 4 is delivered to the downstream side of the throttle valve 7 through the pilot jet 25 and the engine is hence rotated at the idling rotation rate.

Then, as shown in Fig. 2, when the throttle valve 7 is opened, the suction vacuum from the engine is exerted upon the inside of the venturi passage 5. This vacuum condition is transmitted to the upper chamber A of the diaphragm device 3 by means of the connecting passage 14 provided within the piston valve 6. At this time, the atmospheric pressure from the connecting passage 15 is applied to the lower chamber B of the diaphragm device 3, thus the diaphragm 12 being lifted upward owing to the difference in pressure of the vacuum being exerted to the upper chamber A and the atmospheric pressure being applied to the lower chamber B. Then, the piston valve 6 ascends under the interconnection with the diaphragm 12, and the passage area of the venturi passage 5 is expanded. The piston valve 6 is kept stationary by means of the force balance balance between the ascending force, which is caused by the pressure difference between the upper chamber A and the lower chamber B, and the pressing force of the spring 17.

When the piston valve 6 ascends, the needle valve 28 also ascends, and since the needle valve 28 has the tapered outer shape, the circumferential gap between the needle valve 28 and the needle jet 25 increases in accordance with the ascending of the needle valve 28 and the fuel 21 within the float chamber 4 is hence sucked into the venturi passage 5 via this gap. The fuel 21 which has been sucked out is dispersed as a mist and becomes an air-fuel mixture. The air-fuel mixture is then sucked into the engine and the engine revolution is increased.

In this way, the passage area of the venturi passage 5 is automatically adjusted to supply the suitable quantity of fuel according to the opening degree of the throttle valve 7 by means of the piston valve 6, and when the fuel of the quantity corresponding to this passage area is provided to the inside of the venturi passage 5, the air-fuel mixture of an optimum air-fuel ratio is constantly supplied to the engine side.

Concerning this vacuum response type carburetor 1, the diaphragm 12 of the diaphragm device 3 is formed of hydrogen impregnated NBR as mentioned hereinbefore. The following Table 1 is a comparison of the properties of hydrogen impregnated NBR as compared with those of hydrine rubber and NBR, used to form the diaphragm in conventional vacuum response type carburetors.

[Table 1]

	Hydrine Rubber	NBR	Hydrogen Impregnated NBR
Tensile strength [kg/cm^2]	130	160	270
Elongation Ratio [%]	300	600	600
Swelling Ratio [%]	30	20	20
Durability [10000 time operation]	9	25	50

As can be seen from this table, the tensile strength of the hydrogen impregnated NBR was 70 to 100% greater than that of the hydrine rubber or NBR, and the elongation ratio thereof was far better than that of the hydrine rubber, as well. When swelling testing was conducted using a poor quality gasoline, the hydrogen impregnated NBR showed approximately 10% less swelling than the swelling of the hydrine rubber.

Further, when the poor quality gasoline was used to test the durability of the diaphragm, the diaphragm formed of the hydrogen impregnated NBR according to the present invention recorded 500,000 times durability deformations, far exceeding the 90,000 times of the hydrine rubber and the 250,000 times of the NBR, which are utilized in the conventional structure.

As can be resulted from the above, a diaphragm formed of the hydrogen impregnated NBR provides a high chemical resistance and is hardly deteriorated even in use of a poor quality gasoline, so that trouble

such as early rupturing of the diaphragm or hardening thereof can be effectively avoided. Substantially the same result was obtained in a case of the high-octane gasoline and alcohol fuel, thus providing the improved durability. Similar results were also obtained by a diaphragm formed of a fluoro rubber.

Moreover, since the hydrogen impregnated NBR or fluoro rubber has higher tensile strength, if it is required to obtain the same tensile strength as that of conventional material, the film thickness of the diaphragm can be made thinner than the case of the conventional material. If the film thickness of the diaphragm is made thinner, the rigidity is lowered and the flexibility is increased, so that the friction of the piston valve 6 during the movement thereof is decreased, and as shown in Fig. 3, the ascending speed of the piston valve following the opening of the throttle valve 7 is increased, that is the amount of ascending of the piston valve 6 is increased per time unit. Therefore, the throttle response can be remarkably improved.

Furthermore, this vacuum response type carburetor 1 is equipped with the seal members such as the gasket 30 and the O-rings 31, 32, 33, etc. formed of the hydrogen impregnated NBR or fluoro rubber, so that deterioration of these seal members 30, 31, 32 and 33 caused by a gasoline of poor quality, high-octane gasoline or alcohol fuel, etc., can be effectively avoided, thereby effectively preventing fuel leakage and improper settings.

Still furthermore, the hydrogen impregnated NBR or fluoro rubber may be used not only for the diaphragm 12 and the seal members 30 to 33, but also for other members which are susceptible to adhesion of fuel, such as the oil seals of the crankshaft of a two-stroke-cycle engine or an engine intake pipe for preventing the deterioration from fuel, thus maintaining the initial performance for a long time.

Claims

1. A vacuum response type carburetor provided with a diaphragm device including a diaphragm chamber separated into two chambers by means of a diaphragm and provided with a carburetor body including a venturi passage which is communicated with the diaphragm chamber and in which a throttle valve is disposed, in which a pressure change within the venturi passage caused by opening and closing the throttle valve is transmitted to a diaphragm chamber and the diaphragm is thereby moved up and down thereby opening and closing a piston valve interlocked with the diaphragm, characterized in that said diaphragm is formed of a hydrogen impregnated nitrile butadiene rubber (NBR).

2. A vacuum response type carburetor according to claim 1, wherein seal members disposed in the carburetor to portions requiring liquid-proof property are formed of the hydrogen impregnated NBR.

3. A vacuum response type carburetor according to claim 2, wherein said seal members include a gasket disposed to a mating portion between the carburetor body and a float chamber casing and O-rings disposed to a drain bolt provided for the float chamber casing and to a nozzle member disposed in the float chamber casing.

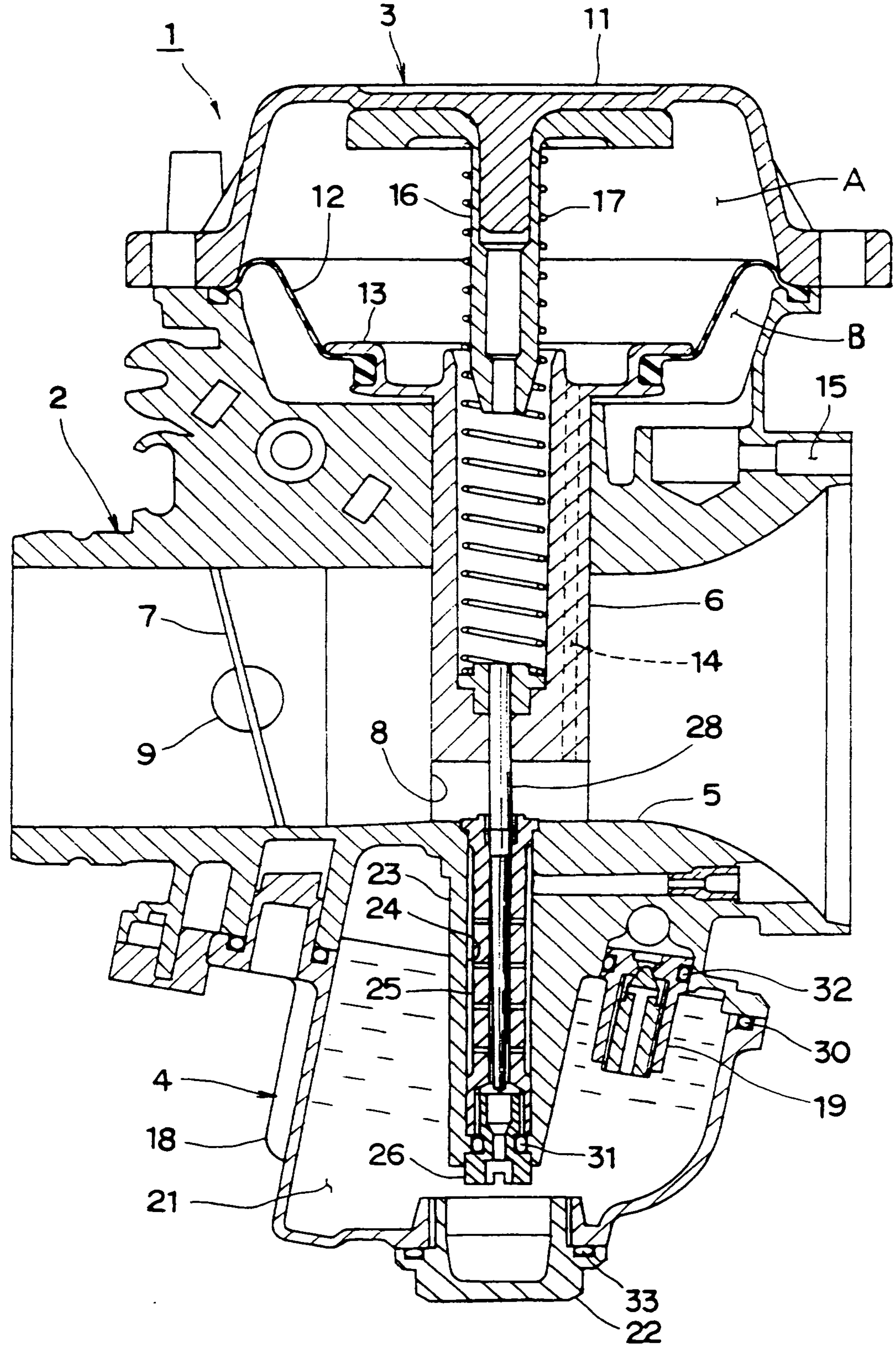
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FIG. 1

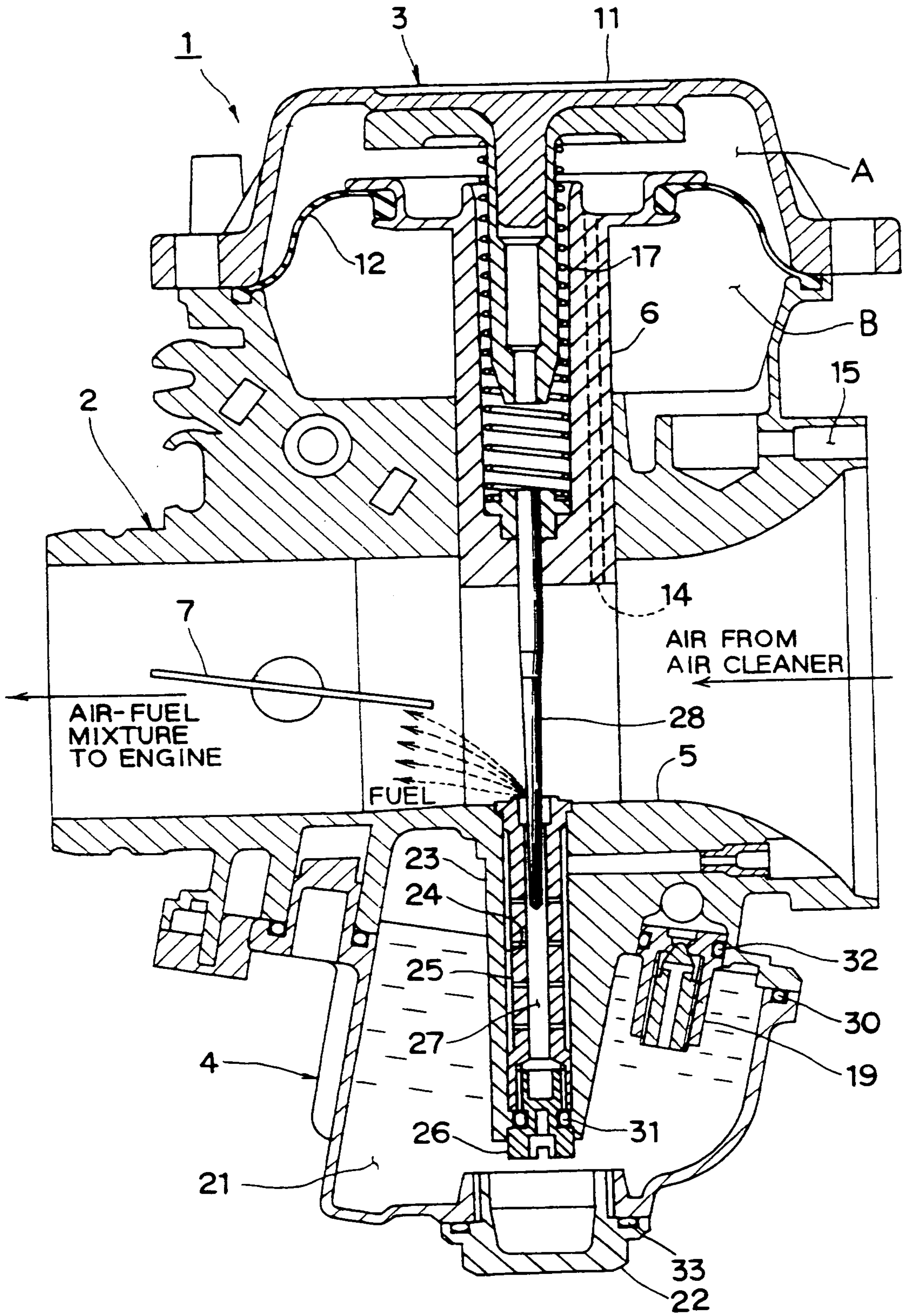
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FIG. 2

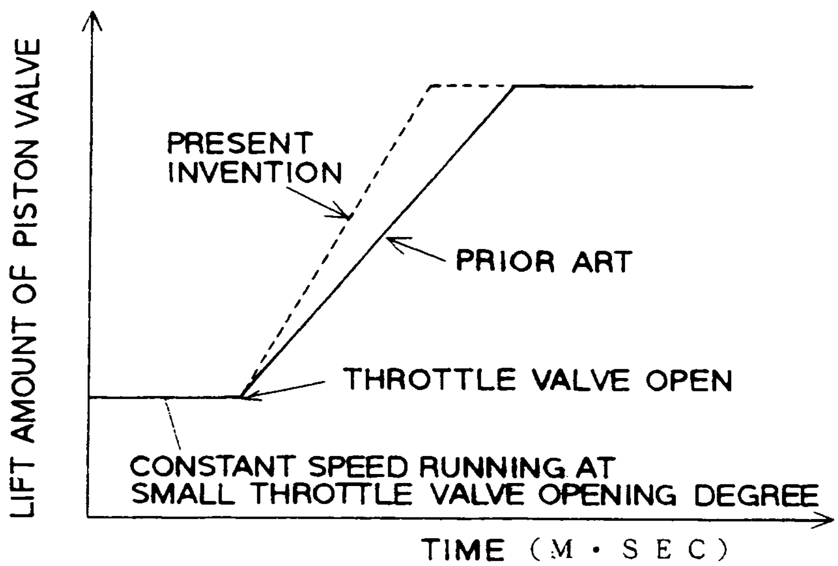
LIFT AMOUNT OF PISTON VALVE
PRESENT INVENTION
PRIOR ART
THROTTLE VALVE OPEN
CONSTANT SPEED RUNNING AT SMALL THROTTLE VALVE OPENING DEGREE
TIME (M・SEC)

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 8044

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	PATENT ABSTRACTS OF JAPAN vol. 11, no. 388 (M-652) 18 December 1987 & JP-A-62 157 269 (KEIHIN SEIKI MFG CO LTD) 13 July 1987	1	F02M17/08
A	* abstract *	2,3	
Y	PATENT ABSTRACTS OF JAPAN vol. 13, no. 296 (M-846) 10 July 1989 & JP-A-01 087 248 (FUJIKURA RUBBER LTD) 31 March 1989 * abstract *	1	
A	US-A-4 323 521 (MORGENROTH) 6 April 1982 * column 4, line 48 - column 7, line 47; figures 1,2,3 *	1-3	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 February 1995	Van Zoest, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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& : member of the same patent family, corresponding document